OUR BOOK SHELF.

Experimental Plant Physiology. By D. T. MacDougal. (New York: Henry Holt and Co., 1895.)

THIS little book is intended primarily for the use of elementary students of vegetable physiology, and the subject-matter is treated in a somewhat dogmatic fashion. This we cannot avoid regarding as a mistake. The elementary, no less than the more advanced, student requires to be made at the outset to *think for himself*, and this is a far more important matter than the mere following out of directions for experiments. But it is just this stimulus that we miss, in the pages before us, and in not a few instances the author has sacrificed reality at the shrine of conciseness; thus it is simply useless to compare the mechanism by which water "is taken up and forced into the root and upward in the stem" to the action of an osmometer, for the conditions are not at all the same. The state of the water, as it exists in, and finds its way upward into, the tracheids, is by no means directly comparable with that of the solution of salts as it occurs in the tube of a thistle funnel, the lower end of which is closed by a piece of membrane. Here was a good opportunity of insisting on the peculiarity of a living protoplasmic structure, and it was lost. Very few teachers, who are at all *au courant* with their subject, will accept the statements as to ascent of sap, given on pages 28 and 29. "The rectangular wood cells are in the form of a series of chains. Water transpired from the topmost cells of these chains, the cell sap becomes concentrated. . . . There is thus formed a series of osmometers extending from the leaves to the roots and capable of lifting water to any height." Surely a slight knowledge of elementary physics, combined with that of the structure of the "wood cells," should have rendered it impossible that such a passage could have been written.

Again on page 46, one is tempted to wonder whether the author can have ever tried the experiment (54) to prove that oxygen is necessary for *respiration.* Any unwary teacher who performed that experiment for the first time before an intelligent class, would probably have a hard time of it if he trusted himself to Mr. MacDougal's guidance.

The above remarks and quotations will show that there are weak points about the book. And, indeed, the general impression left on the reader's mind is the rather painful one, that an important branch of botanical study has here been but superficially handled.

Exercises in Physical Measurement. By Dr. L. W. Austin and Dr. C. B. Thwing. Pp. x + 193. (Boston: Allyn and Bacon, 1896.)

AFTER working through the experiments described in this volume, a student will have a thorough knowledge of the instruments and methods employed in physical measurement, and will be in a position to accurately investigate physical phenomena. The book is a medium between such a hand-book as the last edition of Kohlrausch's "Praktische Physik" and the elementary text-books in which mathematical formulæ are eschewed. The sixty-five exercises in the first part are all quantitative, and they cover measurements in the chief branches of physics, beginning with measures of length, and ending with experiments on polarisation; while the apparatus required for the experiments should form part of the equipment of all physical laboratories in which students can obtain scientific instruction.

In the second part of the book suggestions are given as to methods of computation and physical manipulations, while the third part is taken up with tables. The book is thoroughly practical and trustworthy, and it can be recommended as a suitable introduction to serious work in physics.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Age of the Wealden.

THE Wealden formation of England has long been studied, and is now well known in nearly all its features. Its stratigraphical relations and its Cretaceous age are usually regarded as fully determined, and this is true, also, of the corresponding strata on the continent.

The vertebrate fauna of the Wealden is of special interest, and has attracted much attention ever since Mantell in 1825 unearthed Iguanodon in the Tilgate Forest. Some of the remains, he sent, through his friend Prof. Silliman, to Yale College, where they have proved of much service. In 1865, I examined the same famous locality, as well as others on the south coast of England especially rich in vertebrate fossils, and at all of them secured interesting specimens. A study of these in connection with the collections at London and Brussels first caused me to question the Cretaceous age of the Wealden, and a later comparison of its reptilian fauna with allied forms found in the Rocky Mountains led me to the conclusion that both series were Jurassic in type, and should be placed in that division of the geological series.

At the meeting of the British Association at Ipswich, in September last, I read a paper on European Dinosaurs, including two from the Wealden, and thus the question of their geological age came up for determination. The facts I then presented, based mainly upon the reptilian fauna, strongly indicated the Jurassic age of the Wealden, and I urged a re-examination of the question by English geologists. The subject has since been taken up by Smith Woodward, with special reference to the fossil fishes. In the *Geological Magazine* for February 1896, he gives the main results of his investigation, which prove that the fishes, also, of the Wealden are of Jurassic types, thus placing the geological age of this formation beyond reasonable doubt. The concluding statement of this interesting article is as follows:

"The Wealden estuary seems to have been the last refuge of the Jurassic marine fish-fauna in this part of the world, not invaded even by stragglers from the dominant race of higher fishes which characterised all the seas of the Cretaceous period. The Wealden river drained a land where a typically Jurassic flora flourished; the only two known Mammalian teeth from the Wealden resemble those of a Purbeckian genus; and now it is clear that the fishes agree both with these and the reptiles in their alliance with the life of the Jurassic era." O. C. MARSH.

Yale University, New Haven, Conn., February 22.

The Röntgen Rays.

THE following fact regarding the X-rays of Röntgen may be of interest.

I have found that it is possible to obtain a photographic image by these rays, using a "pinhole camera," having the aperture pierced in a piece of sheet-lead backed with aluminium. The Crookes' tube was illuminated by discharges from a Thomson high-frequency coil. The photographs taken in this way show very distinctly the two electrodes, while the glass bulb, which appeared to be brightly illuminated to the eye, is scarcely perceptible It would appear from this that nearly, if not all, the so-called X-rays proceed directly from the electrodes of the tube, and not from the glass where this is acted on by the kathode rays. It likewise affords further illustration of the rectilinear motion of the X-rays. Experiments are in progress with a broken current, and also to study the effect of a magnetic field.

Previous observation has shown that photographic effects were produced equally whether the kathode rays impinged upon the glass, or upon other phosphorescent material (*e.g.* aragonite) within the tube. It has also been noticed in experiments in this laboratory, that the appearance of the tube to the eye affords no criterion of its efficiency in producing the X-rays; tubes showing but little fluorescence of the glass composing them often giving admirable photographic effects, which in some cases are obtainable even from a low-vacuum Geissler tube. But the rays

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producing photographic effects always appear to produce strong fluorescent effects on platino-cyanide of barium, so that the fluorescence of this affords an indication of the photographic efficiency of the radiations emitted from the tube.

RALPH R. LAWRENCE.

Massachusetts Institute of Technology,
Boston, February 26.

Is it quite correct, as Prof. Lodge puts it, to call the X-rays *anodic* because they start from a point (surface of glass, or of metal foil, &c.) opposite the kathode? It may be true that a surface upon which the kathodic discharges are being directed acquires thereby some properties common to the anode: but it is not an actual anode. Further, I think that so far there is no proof that these rays start from an anode unless that anode is itself in the line of the kathodic discharge. Hence I submit that *anti-kathodic* would be a more correct term to use in describing them. They can certainly be made to start from a portion of the kathode itself by shaping it so as to concentrate the kathodic discharges (or "radiant matter") upon a prolongation of itself.

Whilst dealing with this point, might I mention that a phosphorescent enamel, made by incorporating calcium sulphide in a very fusible enamel-glass, appears to form an excellent anti-kathodic surface for generating X-rays.

SILVANUS P. THOMPSON.

Finsbury Technical College, March 9.

WE enclose a print of a "Röntgen" photograph taken by us some time ago, which shows very clearly that it is to the mineral constituents that bone owes its opacity to the "X-rays." Two human finger-bones were obtained as nearly alike as possible. One was decalcified by treatment with dilute hydrochloric acid for some days, the other being soaked in water for the same period. The calcium phosphate, carbonate, &c., dissolved by the hydrochloric acid, were precipitated by ammonia and ammonium carbonate, and the precipitate, after washing, was spread on paper, so as to cover an area about equal to that which would be covered by the original bone. This precipitate, together with the bone which had merely been soaked in water, and the "decalcified" bone (which had shrunk during treatment with the acid), were then placed upon a photographic plate and exposed in a cardboard box to the radiations from a Crookes' tube excited by a small "Tesla" apparatus.

The picture thus obtained, shows clearly that while the decalcified bone is almost without action on the "X-rays," the mineral matter is practically as opaque as the bone before treatment with acid.

The print shows, however, that both the original bone and the calcium phosphate are only relatively opaque, but that they do allow some "rays" to pass, for the photograph shows half-tones, and not merely an outline.

J. D. CORMACK.
HERBERT INGLE.

The Yorkshire College, Leeds, March 4.

REMEMBERING that scientific men are pledged, beyond all others, to accuracy and observance of rule, I am emboldened to protest against the use of two words which are sometimes employed to describe the pictures produced through the agency of Röntgen's rays. I mean "shadowgram" and "radiogram."

Both of these offend against a primary rule for the formation of new compound words, which requires that all of the component parts of any word shall be derived from one and the same language.

If a word be desired which shall signify a picture produced by rays, let us go to the Greek language only, and form the word "actinogram"; or to the Latin language only, and form the word "radioscript"; or else let us be content with some purely English compound, such as "ray-sketch."

G. H. P.

The Aurora at Waterford.

AFTER a boisterous day and a barometer that went down to 28·85, we were favoured last (Wednesday) night with an auroral display. It was first seen here at 8 o'clock, when it appeared in a cloudless, starlit sky as a sheaf of light springing from the western point of the horizon, and stretching along an arc of 30° up towards the Pleiades.

Its colour, at first silvery white, gradually faded away, reappearing in thin streaks and irregular patches of yellowish light in various parts of the sky between north and west.

At 10.30, it was round in the north. At one time, six well-distanced streaks were counted. They seemed to converge slightly towards the zenith. The light was mainly yellowish, but tinged here and there with pulsating reddish rays. The flickering, or fluctuation in colour and brightness, was distinctly noticeable.

The phenomenon was not observed after 11.30.

As auroræ are essentially electrical in character, having some analogies with the brush discharge, it would be interesting to know whether, like the brush discharge from induction coils and influence machines, *shadowgraphs* might be taken by means of these weird rays. Opportunities for testing their photographic qualities occur very frequently in higher latitudes than ours, and even nightly in circumpolar regions, the home of this interesting phenomenon.

M. F. O'REILLY.

De La Salle Training College, Waterford, March 5.

An Unusual Meteor.

AT 8.31 on Sunday evening, March 1, when half a mile north of York Minster, I caught sight of a meteor slowly falling vertically almost due east. It was then passing over the two small stars ν and ξ Ursæ Majoris, which at the time were at an altitude of 43°, azimuth 5° north of east. Seeing that it meant to last awhile, I proceeded to repeat the alphabet in the orthodox manner (once through, each letter quickly but distinctly enunciated, requiring 4 seconds). Having gone over it twice, I must confess that my amazement at the meteor's duration made me pause. But it kept on, so I continued, getting through it twice more. Then, after a second involuntary but very unscientific pause, I finished the alphabet a fifth time before the phenomenon came to a close. In all, I must have watched it at least 25 seconds. After some 10 seconds, when about the same altitude as β Leonis (24°), a smaller meteor (fourth magnitude) appeared 1° to the left, at an angle of about 40°, and, proceeding at the same speed of under 2° per second, lasted 3 or 4 seconds. The original, of which this was doubtless a fragment, was between first and second magnitude, but with a distinct disc, and was followed by a train of sparks, reddish like itself, which was never more than 2° or 3° long, or lasting only 1 or 2 seconds. The fragment had also a slight train. The main mass seemed to pause slightly about this spot, perhaps because of this explosion. From the first it moved slower and slower, doubtless an effect of perspective, and finally disappeared almost due east (within 5° north of east), only 5° or so above the horizon, in the unusually clear sky just above the rising moon.

Whilst making notes, a gentleman came by, who said that he had seen it earlier, when as high as, and very near τ and μ Ursæ Majoris (the hind paw), or about an altitude of 58°, 5° north of east. Thus its angular path was 53°. As the additional distance was nearly half that observed by myself, it must have been visible for at least 7 seconds before I saw it, or 32 seconds in all. This makes due allowance for its apparently quicker motion at first. But the gentleman himself thought that he had not seen the actual commencement.

It is to be hoped that some other reports will be received, for its path must have been of extraordinary length, even if it was only travelling at ten miles per second, which is the almost irreducible minimum for a meteor.

A third observer saw it from indoors, appearing from above the window and falling vertically down the panes. It is a reasonable assumption, for a meteor of so great duration, that it first appeared at a height of 100 miles and reached within 30 miles of the earth. If so, its approximate path would be from above 25 miles off Bridlington to the coast of Denmark, north-east of Heligoland. The flight would be 360 miles, or rather over 10 miles per second.

Bootham, York. J. EDMUND CLARK.

RECENT WORK OF THE GEOLOGICAL SURVEY OF THE UNITED STATES.

I.

OWING to the fact that much of the sphere of operations of this Survey lies in a new country, it is compelled to undertake a great deal of work of a class which does not usually fall to the lot of a body of geologists; chief amongst this stands topographical

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